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DEPARTMENT OF THE ARMY FIELD MANUAL

NUCLEAR PLAY CALCULATOR

HEADQUARTERS, DEPARTMENT OF THE ARMY

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NUCLEAR PLAY CALCULATOR

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CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Purpose and Scope

a. This manual provides guidance on procedures and techniques for evaluating the nuclear play of Allied forces during tactical exercises.

b. This manual provides the necessary aids in determining the assessments to hostile forces of nuclear strikes performed by Allied forces with hypothetical weapons.

1-2. Definitions of Terms Used in this Manual

a. Nuclear play calculator (NPC)—A device for applying performance probabilities to nuclear delivery systems.

b. Horizontal dispersion template—An aid which is used by the control umpire to determine the actual ground zero (AGZ) of the nuclear weapon. The letters in the horizontal dispersion table correspond to those on the template and indicate the distance the weapon impacted from ground zero. A zero indicates a detonation at the desired ground zero.

c. Damage letters—Letters which signify different target categories normally assessed in nuclear weapons employment.

d. Damage circle template—An aid used in conjunction with the damage letters to evaluate the damage to hostile forces and equipment.

e. Target element table—A table which describes the target categories and the damage to be expected within each lettered damage circle.

f. Damage circle radii—The radii of damage for a particular type of target.

g. Damage circle radii tables—A series of tables showing the damage radii, in hundreds of meters, to be assessed for each target category, based on the height of burst (HOB) and the weapon yield. Data given are for commonly occurring target elements. For target elements not enumerated, damage corresponding to the most closely related item shown is assessed.

1-3. Changes to the Manual

Users of this manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded to Commandant, U. S. Army Artillery and Missile School, ATTN: AKPSIPL, Fort Sill, Okla.

1-4. References

See appendix A for list of references.

1-5. Organization

a. Chapter 1 provides an introduction to the manual and an explanation in the use of the nuclear play calculator in evaluating the strike effects in nuclear play.

b. Chapter 2 contains the tables for strike assessments by umpires of nuclear weapons.

c. Chapter 3 contains the damage radii tables for the nuclear weapons employed by the Allied Forces.

Section II. INSTRUCTIONS FOR USE OF THE NUCLEAR PLAY CALCULATOR

1-6. Purpose and Use of the Nuclear Play Calculator

a. The nuclear play calculator is designed to provide a simple and convenient means for applying weapon performance probabilities in determining the actual ground zero and various damage radii resulting from a nuclear burst simulated during tactical exercises.

b. To obtain the maximum value from a training standpoint, elements of the target area must be portrayed in appropriate detail on a map used with the nuclear play calculator. A map scale of 1:50,000 or larger is appropriate for this purpose. If a map of the required scale is not available, a grid sheet showing the most prominent terrain features may be substituted.

c. To achieve a better evaluation when small, tactical nuclear weapons (less than 100 KT) are employed, the area occupied by the smallest tactical unit (normally a platoon) should be indicated on the map or sketch used for damage assessment. With very small-yield weapons, target detail should include each individual crew-served weapon, tank, and squad-size unit.

d. A detailed comparison of evaluation of strike assessments when maps of different scales are used is presented in appendix B.

1-7. Control Organization

When special weapons are played in any tactical exercise the umpire/control organization must be compatible with player organization and staffing. The umpire/control organization is generally organized along the same lines as players in the special weapons area at each player echelon.

1-8. Control Operation

a. Upon notification that a nuclear weapon is to be employed all control staff sections are alerted.

b. The following information must be received for a strike assessment.

(1) *Army-delivered weapons.*
- (*a*) Delivery system (short-range cannon, heavy guided missile etc.).
- (*b*) Location of the delivery unit (coordinates).
- (*c*) Desired ground zero (coordinates).
- (*d*) Desired height of burst in meters.
- (*e*) Yield in kilotons.
- (*f*) Time of delivery.

(2) *Air-delivered weapons.*
- (*a*) Type of delivery aircraft (fighter, tactical bomber).
- (*b*) Direction of flight over target.
- (*c*) Desired ground zero (coordinates).
- (*d*) Desired height of burst in meters.
- (*e*) Yield in kilotons.
- (*f*) Time of delivery.

1-9. Strike Assessment

a. The appropriate echelon of the umpire/control organization makes a strike assessment (fig. 1-1) using the suitable section of chapter 2 for the delivery system indicated.

The following steps are required to make the strike assessment.

(1) Determine in-flight performance.
(2) Locate the actual ground zero of the weapons.
(3) Find the actual height of burst.
(4) Determine from the appropriate tables in chapter 3 the damage circle radii applicable to the strike conditions determined for the assessment.

b. Upon completion of the strike assessment the following information is disseminated.

(1) The coordinates of actual ground zero.
(2) A target letter and the corresponding damage radii for each of the target elements of interest for the strike.
(3) Time of delivery of the weapon.

c. The control organization determines whether fallout will occur in case of a surface or a low air burst. This is determined from the column in the damage circle table marked "FAF" (fallout adjustment factor). A zero in this column indicates no militarily significant fallout; any number other than zero indicated militarily significant fallout. The dose rate values considered proper for a surface burst must be multiplied by the fallout adjustment factor to correct for the actual burst height condition. The chemical, biological, and radiological umpire should be notified that fallout will occur and should be given the fallout adjustment factor so that he may consider this adjustment in establishing fallout patterns.

d. The information from the completed strike assessment form becomes the basic data for transmission of information to players and for reports by various controllers.

ASSESSMENT SHEET FOR NUCLEAR MISSIONS

1. Mission number:_____
2. Input data:

Army-delivered systems

a. Delivery system:_____
b. Location of delivery unit:_____
(coordinates)
c. DGZ:_____
(coordinates)
d. Desired HOB (meters):_____
Preset HOB option:_____
e. Yield KT:_____
f. Time of delivery:_____

Air-delivered systems

a. Type of aircraft:_____
b. Direction of flight:_____
c. DGZ:_____
(coordinates)
d. Desired HOB (meters):_____
e. Yield KT:_____
f. Time of delivery:_____

3. Dud or failed-safe occurrence: Yes_____. No_____.
4. Range in meters (Army-delivered weapons only):_____.
5. Determination of actual ground zero:
   Desired ground zero (from paragraph 2c above):_____.
   Throw one die. Number:_____. Sector line_____.
   Throw three dice. Sum:_____. Dispersion circle, (line or ellipse):_____.
   Actual ground zero:_____.
   (coordinates)
6. Determination of actual height of burst:
   Throw three dice. Sum:_____.
   Desired HOB (from par. 2 above):_____.
   Vertical error (including sign):_____.
   Actual HOB (meters):_____.
7. Damage circle (from actual HOB and yield):

T_____ P_____ DP_____ B_____ TB_____ C_____
V_____ X_____ DX_____ I_____ FAF_____

Figure 1–1. Sample assessment sheet.

CHAPTER 2
STRIKE ASSESSMENT PROCEDURES

Section I. STRIKE ASSESSMENT PROCEDURES FOR SHORT-, MEDIUM-, AND LONG-RANGE CANNONS

2–1. In-Flight Performance

To determine in-flight performance, roll three dice. If the sum is 3, the round is a dud. Notify the appropriate umpires and proceed no further.

Note. Delays, aborts, or malfunctions caused by improper actions at the delivery unit should be assessed by the delivery unit umpire, and the appropriate umpires should be notified. Weapon performance probabilities included in this section assume a correct firing of the round.

2–2. Actual Ground Zero

To determine the actual ground zero, place the horizontal dispersion template for this weapon over the desired ground zero (DGZ) with the direction of fire properly alined. Throw three dice and enter table 2–1 with the sum of the dice and the range to determine a letter that designates the proper dispersion line. The intersection of this dispersion line with the direction-of-fire line will be the actual ground zero.

Table 2–1. Horizontal Dispersion (Short-, Medium-, and Long-Range Cannons)

Sum of dice	Range (in thousands of meters)													
	2 to 4	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14 to 16	16 to 18	18 to 20	20 to 22	22 to 24	24 to 26	26 to 28	28 to 30
3	c	o	e	a	o	a	i	a	a	e	a	c	g	g
4	o	e	a	o	c	o	i	o	o	a	c	a	g	g
5	a	c	a	g	i	e	i	o	o	o	o	o	o	o
6	o	o	e	c	g	o	o	g	a	a	a	a	a	a
7	a	c	c	o	o	e	g	a	e	e	c	c	c	c
8	a	a	c	e	e	a	a	e	g	c	e	e	e	e
9	o	a	o	c	a	i	e	c	c	i	g	g	k	k
10	o	o	a	a	c	c	c	i	i	g	i	k	i	i
11	o	o	b	b	d	d	d	j	j	h	j	l	i	j
12	o	b	o	d	b	j	f	d	d	j	h	h	l	l
13	b	b	d	f	f	b	b	f	h	d	f	f	f	f
14	b	d	d	o	o	f	h	b	f	f	d	d	d	d
15	o	o	f	d	h	o	o	h	b	b	b	b	b	b
16	b	o	b	h	j	f	j	o	o	o	o	o	o	o

Table 2-1—Continued

Sum of dice	Range (in thousands of meters)													
	2 to 4	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14 to 16	16 to 18	18 to 20	20 to 22	22 to 24	24 to 26	26 to 28	28 to 30
17	o	f	b	o	d	o	j	o	o	b	d	b	h	h
18	d	o	f	b	o	b	j	b	b	f	b	d	h	h

2-3. Actual Height of Burst

To determine the actual height of burst, throw three dice. Enter table 2-2 with the sum of the dice and the range and determine the vertical error. If the sum of the dice is odd, subtract the error from the desired height of burst; if the sum is even, add the error to the desired height of burst to find the actual height of burst. A negative actual height of burst should be read as an impact round and considered a dud. If a dud occurs from this cause, notify the appropriate umpires and proceed no further.

Table 2-2. Range and Vertical Error (Short-, Medium-, and Long-Range Cannons)

10 or 11	0	0	0	0	0	5	5	5	5	5	10	10	10	10	10
9 or 12	0	5	5	10	10	10	15	15	20	20	20	20	25	25	30
8 or 13	5	10	10	15	15	20	25	30	30	30	35	40	40	45	50
7 or 14	5	10	15	20	25	30	35	40	40	45	50	55	60	65	70
6 or 15	10	15	20	25	30	40	45	50	55	60	65	70	75	85	90
5 or 16	10	20	25	35	40	50	55	60	65	75	80	90	95	100	110
4 or 17	15	25	35	40	50	60	65	75	85	95	100	110	120	125	135
3 or 18	20	30	40	50	60	70	80	95	105	115	125	135	145	155	165
	↑ Vertical error (in meters) for ranges 2–16 kilometers														
Sum of dice	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	↕ Range (in kilometers)														
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
	↓ Vertical error (in meters) for ranges 17–30 kilometers														
10 or 11	10	10	10	15	15	15	15	15	15	15	15	20	20	20	
9 or 12	30	30	35	35	35	40	40	40	45	45	50	50	50	50	
8 or 13	50	55	60	60	65	65	70	70	75	80	80	85	90	90	

Table 2-2—Continued

7 or 14	75	75	80	85	90	95	100	100	105	110	115	120	125	130
6 or 15	95	100	105	110	120	120	130	130	140	140	150	155	160	165
5 or 16	120	125	130	135	145	150	160	165	170	180	190	190	200	205
4 or 17	145	150	160	170	180	185	195	200	210	220	230	240	250	260
3 or 18	175	185	200	210	220	230	240	250	260	270	280	290	300	310

2-4. Damage Circle

To determine the damage circle, enter the damage circle radii tables in chapter 3 with the yield of the weapon and the actual height of burst (par. 2-3) to determine the damage circle numbers for the target elements of interest in this strike.

Section II. STRIKE ASSESSMENT PROCEDURES FOR SMALL AND LARGE FREE ROCKETS

2-5. In-Flight Performance

To determine in-flight performance, roll three dice. If the sum is 3 or 18, the round is a dud. Notify the appropriate umpires and proceed no further.

Note. Delays, aborts, or malfunctions caused by improper actions at the delivery unit should be assessed by the delivery unit umpire, and the appropriate umpires should be notified. Weapon performance probabilities included in this section assume a correct firing of the rocket.

2-6. Actual Ground Zero

To determine the actual ground zero--

a. Place the horizontal dispersion template for this weapon over the desired ground zero with the direction of fire properly alined.

b. Throw one die. The number on the die designates a radial line in table 2-3. This line is the proper radial direction line on the horizontal dispersion template of this weapon.

c. Throw three dice and enter table 2-4 with the sum of the dice and the range to determine a letter that designates the proper dispersion ellipse. The intersection of this dispersion ellipse with the radial line determined in *b* above will be the actual ground zero.

Table 2-3. Direction (Small and Large Free Rockets)

Number	Direction
1	I
2	II
3	III
4	IV
5	V
6	VI

2-7. Actual Height of Burst

a. To determine the actual height of burst when an impact burst is desired, use a surface height of burst.

b. To determine the actual height of burst when an airburst is desired, throw three dice. Enter table V with the sum of the dice and the range and determine the vertical error. If the sum of the dice is odd, subtract the error from the desired height of burst to find the actual height of burst. If the sum is even, add the error to the desired height of burst to find the actual height of burst. A negative actual height of burst should be considered a dud. If a dud occurs from this cause, notify the appropriate umpires and proceed no further.

2-8. Damage Circle

To determine the damage circle, enter the damage circle radii tables in chapter 3 with the yield of the weapon and the actual height of burst (par. 2-7) to determine the damage circle numbers for the target elements of interest in this strike.

Table 2-4. Horizontal Dispersion (Small and Large Free Rockets)

Sum of dice	Range (in thousands of meters)							
	3 to 5	5 to 10	10 to 15	15 to 20	20 to 25	25 to 30	30 to 35	35 to 40
3	a	a	b	e	c	f	e	e
4	a	o	o	o	o	b	d	a
5	a	a	b	c	d	f	g	f
6	b	c	e	f	g	g	g	i
7	o	a	b	b	a	c	d	b
8	b	b	b	e	d	e	g	h
9	b	a	c	c	e	f	f	f
10	o	a	a	a	b	b	d	d
11	o	a	a	b	c	c	c	e
12	b	b	c	d	f	f	f	g
13	o	o	b	b	b	d	b	c
14	b	b	c	d	e	d	e	g
15	a	a	a	b	c	a	a	e
16	a	a	o	a	a	a	c	e
17	b	b	d	e	f	g	h	h
18	a	b	b	e	c	f	g	e

Table 2-5. Range and Vertical Error (Small and Large Free Rockets)

SUM of dice	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
10 or 11	0	5	5	10	10	10	10	15	15	15	15	20	20	20	20	20	25	25	25
9 or 12	10	15	20	20	25	30	30	35	40	40	45	50	50	55	60	65	65	70	75
8 or 13	15	25	30	35	40	50	55	60	65	70	80	85	90	95	100	105	115	120	125
7 or 14	25	35	40	50	60	70	75	85	95	100	110	120	130	135	145	150	160	170	180
6 or 15	30	45	55	65	75	90	100	110	120	130	140	155	165	175	190	195	210	220	230
5 or 16	40	55	65	80	95	110	125	135	150	165	180	190	205	220	230	250	260	275	290
4 or 17	50	65	85	100	120	135	150	170	185	200	220	240	260	270	290	300	310	340	360
3 or 18	60	80	105	125	145	165	185	210	230	250	270	290	310	330	350	375	390	415	440
	↑ Vertical error (in meters) for ranges 3–21 kilometers																		
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	↕ Range (in kilometers)																		
	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
	↓ Vertical error (in meters) for ranges 22–40 kilometers																		
10 or 11	30	30	30	30	30	35	35	35	40	40	40	40	40	45	45	45	50	50	50
9 or 12	75	80	85	90	90	95	100	100	105	110	110	115	120	120	125	130	135	135	140
8 or 13	130	140	145	150	155	160	170	175	180	185	190	195	200	210	215	220	230	235	240
7 or 14	185	195	205	210	220	230	240	250	255	265	270	280	290	300	310	315	320	330	340
6 or 15	240	250	265	275	285	300	310	320	330	340	350	365	375	385	400	410	420	430	440
5 or 16	300	315	330	345	360	370	385	400	415	425	440	455	470	480	495	510	520	535	550

4 or 17	375	390	410	425	445	460	475	495	510	525	545	560	580	595	610	630	650	665	680
3 or 18	460	480	500	520	540	560	585	605	625	645	665	685	710	730	750	770	790	810	830

Section III. STRIKE ASSESSMENT PROCEDURES FOR LIGHT, MEDIUM, AND HEAVY GUIDED MISSILES

2-9. In-Flight Performance

To determine in-flight performance, roll three dice. If the sum is 8 or 13, the round is a dud or failed-safe. Notify the appropriate umpires and proceed no further.

Note. Delays, aborts, or malfunctions due to improper actions at the delivery unit should be assessed by the delivery unit umpire, and the appropriate umpires should be notified. Weapon performance probabilities included in this section assume a correct firing of the missile.

2-10. Actual Ground Zero

To determine the actual ground zero—

a. Place the horizontal dispersion template for this weapon over the desired ground zero with the direction of fire properly alined.

b. Throw one die. The number on the die designates a radial line in table 2-6. This line is the proper radial direction line on the horizontal dispersion template of this weapon.

c. Throw three dice and enter table 2-7 with the sum of the dice and the proper missile system to determine a letter that designates the proper dispersion circle. The intersection of this dispersion circle with the radial line determined in *b* above will be the actual ground zero.

2-11. Actual Height of Burst

To determine the actual height of burst, throw three dice. Enter table 2-8 with the sum of the dice and the correct missile system and determine the vertical error. If the sum of the dice is odd, subtract the error from the desired height of burst. If the sum is even, add the error to the desired height of burst. A negative height of burst should be considered as an impact or surface burst.

Table 2-6. Direction (Light, Medium, and Heavy Guided Missiles)

Number	Direction
1	I
2	II
3	III
4	IV
5	V
6	VI

Table 2-7. Horizontal Dispersion (Light, Medium, and Heavy Guided Missiles)

Sum of dice	Light guided missile	Medium guided missile	Heavy guided missile
3	b	h	h
4	a	b	b
5	b	e	h
6	c	j	l
7	a	b	g
8	b	g	j
9	b	f	i
10	o	c	g
11	a	d	h
12	a	g	j
13	a	e	f
14	a	f	i
15	a	a	d
16	a	d	c
17	b	h	k
18	b	h	h

Table 2-8. Vertical Error (Light, Medium, and Heavy Guided Missiles)

Sum of dice	Error (in meters)		
	Light guided missile	Medium guided missile	Heavy guided missile
10 or 11	10	15	25
9 or 12	20	35	70
8 or 13	35	60	120
7 or 14	50	85	170
6 or 15	65	110	220
5 or 16	80	135	275

Table 2-8—Continued

Sum of dice	Error (in meters)		
	Light guided missile	Medium guided missile	Heavy guided missile
4 or 17	100	170	340
3 or 18	125	210	415

2-12. Damage Circle

To determine the damage circle, enter the damage circle radii tables in chapter 3 with the yield of the weapon and the actual height of burst (par. 2-11) to determine the damage circle numbers for the target elements of interest in this strike.

Section IV. STRIKE ASSESSMENT PROCEDURES FOR AIR-DELIVERED WEAPONS

2–13. Dud Occurrence

To determine dud occurrence, roll three dice. If the sum is 3 or 18, the round is a dud. Notify the appropriate umpires and proceed no further.

Note. Delays or malfunctions due to improper actions at the departure airfield should be assessed by an Air Force umpire, and the appropriate umpires should be notified. In-flight performance to include damage to or destruction of the aircraft, gross delivery errors, improper delivery, etc., must be assessed by an Air Force controller in accordance with specific exercise conditions of personnel, materiel, weather, air defense capabilities, etc. The only weapon probabilities that are included in this section assume that the bomb has been correctly released by the aircraft in the target area. This dud occurrence is only a minor factor relative to general in-flight performance.

2–14. Actual Ground Zero

To determine the actual ground zero—

a. Place the horizontal dispersion template for air-delivered weapons over the desired ground zero with the direction of flight properly alined.

b. Throw one die. The number on the die designates a radial line in table 2–9. This is the proper radial direction line on the horizontal dispersion template of this weapon.

Table 2–9. Direction (Air-Delivered Weapons)

Number	Direction
1	I
2	II
3	III
4	IV
5	V
6	VI

c. Throw three dice and enter table 2–10 with the sum of the dice and the type of aircraft used to determine a letter that designates the proper dispersion circle. The intersection of this dispersion circle with the radial line determined in *b* above will be the actual ground zero.

2–15. Actual Height of Burst

To determine the actual height of burst, throw three dice. Enter table 2–9 with the sum of the dice and the type of aircraft and determine the vertical error. If the sum of the dice is odd, subtract the error from the desired height of burst. If the sum is even, add the error to the desired height of burst to find the actual height of burst. A negative actual height of burst should be read as an impact round and considered a surface burst.

2–16. Damage Circle

To determine the damage circle, enter the damage circle radii tables in chapter 3 with the yield of the weapon and the actual height of burst (par. 2–15) to determine the damage circle numbers for the target elements of interest in this strike.

Table 2–10. Horizontal Dispersion (Air-Delivered Weapons)

Sum of dice	Fighter	Tactical bomber
3	e	f
4	o	b
5	c	g
6	f	j
7	b	c
8	e	f
9	c	g
10	a	e
11	b	f
12	d	h
13	b	d
14	d	h
15	b	b
16	a	a
17	e	i
18	e	f

Table 2-11. Vertical Error (Air-Delivered Weapons)

Sum of dice	Error (in meters)	
	Fighter aircraft	Tactical bomber
10 or 11	15	25
9 or 12	35	70
8 or 13	60	120
7 or 14	85	170
6 or 15	110	220
5 or 16	135	275
4 or 17	170	340
3 or 18	210	415

Section V. STRIKE ASSESSMENT PROCEDURES FOR ATOMIC DEMOLITION MUNITIONS

2–17. Atomic Demolition Munitions

Atomic demolition munitions (ADM) may be played by assuming a surface burst and a zero horizontal error. Dud occurrence may be determined by rolling three dice. If the sum is 3 or 18, the round is a dud. Delays, aborts, or malfunctions caused by improper actions by the emplacing unit should be assessed by the unit umpire, and the appropriate umpires should be notified. The dud probabilities included here assume that the weapon has been correctly emplaced and fired.

Section VI. STRIKE ASSESSMENT PROCEDURES FOR NEW WEAPONS

2-18. This section is reserved for new weapons.

CHAPTER 3

DAMAGE DETERMINATION

3-1. Target Element Table

Table 3-1 lists the types of targets and the target letters associated with these targets. The meaning of the numbers in the damage circle radii tables are shown also.

Table 3-1. Target Element Table

Target letter	Type of target	Meaning of number transmitted
T	Tanks, artillery, mortars, small arms, machine-guns, masonry or concrete bridges, and recoilless rifles.	Template radius within which 85% are moderately damaged. Within 0.8 of this radius, the equipment will be severely damaged.
	Supply dumps, barbed wire, highway, railroad, and float bridges.	Template radius within which 85% of the supplies are severely damaged.
V	Vehicles, missiles, vehicular-mounted rocket launchers.	Template radius within which 85% are moderately damaged. Within 0.8 of this radius, the equipment will be severely damaged.
	Signal and electronic fire control equipment, radar antenna, and guidance and tracking radar.	Template radius within which 85% are severely damaged.
P	Personnel in tanks or foxholes.	Template radius within which 85% are immediate casulaties. Remaining 15% will be casualties within 1 hour.
X	Personnel in the open.*	Template radius within which 85% are immediate casualties. Remaining 15% will be casualties within 1 hour.
DP	Delayed casualties to personnel in tanks or foxholes.	85% of the personnel in the zone between ring P and ring DP will be casulaties within 1 hour. Remaining 15% will be casualties within 4 hours.
DX	Delayed casulaties to personnel in the open.	85% of the personnel in the zone between ring X and ring DX will be casulaties within 1 hour. Remaining 15% will be casualties within 4 hours.
B	Personnel in multistory apartment buildings.	Template radius within which 25% are killed, 20% are seriously wounded, and 30% are trapped in the debris; obstacles to movement are formed by severe damage to buildings.
T.B.	Tree blowdown, type II forests.*	Template radius within 60% of the trees will be blown down.
I	Induced contamination.	Template radius of the 2 rad/hr circle referenced to H+1 hour for type II soil.
C	Crater.	Radius of the crater in dry soil given in meters.

See footnotes at end of table.

Table 3-1—Continued

Target letter	Type of target	Meaning of number transmitted
FAF	Fallour adjustment factor.	For low airbursts, the dose rate for a surface burst must be multiplied by this factor in order to obtain a rough approximation of the dose rates in the fallout pattern. Zero reading indicates no fallout.

* Tree blowdown in type II forest for obstacles and casualties are found below each Damage circle radii table.

For further evaluation of forests refer to FM 101-31-3.

3-2. Damage Circle Radii

Tables 3-2 through 3-14 list the damage circle radii, in hundreds of meters, for various yields at the heights of burst indicated.

Table 3-2. Damage Circle Radii for 0.5 KT

Actual HOB (meters)	T	V	P	X	DP	DX	B	I	C	FAF
550	0	0	0	0	0	3	0	0	0	0
500	0	0	0	0	0	4	0	0	0	0
450	0	0	0	0	2	4	0	1	0	0
400	0	0	0	1	3	5	1	2	0	0
350	0	0	0	2	3	5	2	2	0	0
300	0	0	0	3	4	6	3	3	0	0
250	0	0	1	3	4	6	3	3	0	0
200	0	0	2	3	4	6	4	4	0	0
150	0	0	2	4	4	6	4	4	0	0
100	0	1	2	4	5	6	4	4	0	0
50	1	2	3	4	5	6	4	4	0	0
S	1	1	3	4	5	6	4	*	16	1

*Fallout governs.
Tree blowdown type II forests.
Obstacles 300 meters.
Personnel 200 meters.

Table 3-3. Damage Circle Radii for 1 KT

Actual HOB (meters)	T	V	P	X	DP	DX	B	I	C	FAF
600	0	0	0	0	0	4	0	0	0	0
550	0	0	0	1	2	5	0	1	0	0
500	0	0	0	2	3	6	0	1	0	0
450	0	0	0	3	3	6	1	2	0	0
400	0	0	1	4	4	6	2	2	0	0
350	0	0	2	4	4	7	3	2	0	0
300	0	0	2	4	5	7	5	3	0	0
250	0	0	3	5	5	7	5	3	0	0
200	0	0	3	5	5	7	5	4	0	0
150	0	2	3	5	5	7	5	4	0	0
100	1	2	4	5	5	7	5	4	0	0
50	1	2	4	5	6	7	5	4	0	0
S	1	1	4	5	6	7	5	*	20	1

*Fallout governs.
Tree blowdown type II forests.
Obstacles 400 meters.
Personnel 300 meters.

Table 3-4. Damage Circle Radii for 2 KT

Actual HOB (meters)*	T	V	P	X	DP	DX	B	I	C	FAF
750	0	0	0	0	0	4	0	0	0	0
700	0	0	0	0	1	5	0	0	0	0
650	0	0	0	0	2	6	0	1	1	1
600	0	0	0	1	3	6	0	2	0	0
550	0	0	0	3	4	7	2	2	0	0
500	0	0	0	3	4	7	3	2	0	0
450	0	0	1	4	5	7	4	2	0	0
400	0	0	2	4	5	7	4	3	0	0
350	0	0	3	5	6	8	6	3	0	0
300	0	0	3	5	6	8	6	4	0	0
250	0	1	4	5	6	8	6	4	0	0
200	0	2	4	5	6	8	6	5	0	0
150	1	3	4	6	6	8	5	5	0	0
100	1	3	4	6	6	8	5	5	0	0
50	2	3	4	6	6	9	6	5	0	0
S	1	2	4	6	6	9	6	*	25	1

*Fallout governs.
Tree blowdown type II forests.
Obstacles 300 meters.
Personnel 300 meters.

Table 3-5. Damage Circle Radii for 5 KT

Actual HOB (meters)	T	V	P	X	DP	DX	B	I	C	FAF
800	0	0	0	0	2	6	0	0	0	0
750	0	0	0	2	3	7	0	1	0	0
700	0	0	0	3	4	7	1	2	0	0
650	0	0	0	4	5	8	3	2	0	0
600	0	0	1	5	5	8	3	2	0	0
550	0	0	3	5	6	9	4	3	0	0
500	0	0	3	6	6	9	8	3	0	0
450	0	0	4	6	7	9	9	3	0	0
400	0	0	4	7	7	9	9	4	0	0
350	0	1	5	7	7	9	9	5	0	0
300	0	2	5	7	7	10	8	5	0	0
250	0	4	5	7	7	10	8	6	0	0
200	1	4	6	7	8	10	8	6	0	0
150	2	4	6	7	8	10	7	6	0	0
100	3	5	6	8	8	10	7	6	0	0
50	3	4	6	8	8	10	7	*	0	.1
S	2	3	6	8	8	10	7	*	35	1

*Fallout governs.
Tree blowdown type II forests.
Obstacles 800 meters.
Personnel 600 meters.

Table 3-6. Damage Circle Radii for 10 KT

Actual HOB (meters)	T	V	P	X	DP	DX	B	I	C	FAF
950	0	0	0	0	0	7	0	0	0	0
900	0	0	0	0	2	7	0	0	0	0
850	0	0	0	2	3	8	0	1	0	0
800	0	0	0	4	4	8	1	2	0	0
750	0	0	0	5	5	9	5	2	0	0
700	0	0	1	5	6	9	6	3	0	0
650	0	0	2	6	6	9	12	3	0	0
600	0	0	3	6	7	10	12	3	0	0
550	0	0	4	7	7	10	12	3	0	0
500	0	0	5	8	7	10	12	4	0	0
450	0	1	5	8	8	10	12	5	0	0
400	0	2	5	8	8	11	11	6	0	0
350	0	4	6	8	8	11	11	6	0	0
300	1	5	6	8	8	11	10	6	0	0
250	1	6	6	8	9	11	10	6	0	0
200	2	6	6	8	9	11	10	7	0	0
150	3	6	7	8	9	11	9	7	0	0
100	3	6	7	9	9	11	9	7	0	0
50	3	6	7	9	9	11	9	*	0	.1
S	3	4	7	9	9	11	8	*	40	1

*Fallout governs.
Tree blowdown type II forests.
Obstacles 1,000 meters.
Personnel 800 meters.

Table 3-7. Damage Circle Radii for 20 KT

Actual HOB (meters)	T	V	P	X	DP	DX	B	I	C	FAF
1,050	0	0	0	0	0	7	0	0	0	0
1,000	0	0	0	0	2	7	0	0	0	0
950	0	0	0	3	4	8	4	1	0	0
900	0	0	0	4	5	8	6	2	0	0
850	0	0	0	5	5	9	8	2	0	0
800	0	0	0	6	6	9	11	2	0	0
750	0	0	2	6	7	10	15	3	0	0
700	0	0	4	7	7	10	15	3	0	0
650	0	0	4	10	8	10	15	4	0	0
600	0	0	5	11	8	11	15	4	0	0
550	0	2	5	11	8	11	14	5	0	0
500	0	3	6	11	9	11	14	6	0	0
450	0	6	6	11	9	11	13	6	0	0
400	1	7	7	11	9	12	13	6	0	0
350	2	7	7	11	9	12	12	7	0	0
300	2	8	7	11	9	12	12	7	0	0
250	3	8	7	11	10	12	12	7	0	0
200	4	8	7	11	10	12	12	8	0	0
150	5	8	8	11	10	12	11	8	0	0
100	5	8	8	10	10	12	11	8	0	0
50	5	7	8	10	10	12	11	*	40	.2
S	4	6	8	10	10	12	11	*	50	1

*Fallout governs.
Tree blowdown type II forest.
Obstacles 1,300 meters.
Personnel 1,000 meters.

Table 3-8. Damage Circle Radii for 50 KT

Actual HOB (meters)	T	V	P	X	DP	DX	B	I	C	FAF
1,300	0	0	0	0	0	7	9	0	0	0
1,250	0	0	0	0	0	8	11	0	0	0
1,200	0	0	0	0	0	8	13	0	0	0
1,150	0	0	0	2	2	9	14	0	0	0
1,100	0	0	0	4	4	9	21	1	0	0
1,050	0	0	1	5	5	10	21	2	0	0
1,000	0	0	3	6	6	10	21	3	0	0
950	0	0	4	7	7	11	21	3	0	0
900	0	0	5	13	7	13	21	3	0	0
850	0	0	6	15	8	15	21	4	0	0
800	0	1	7	16	8	16	21	4	0	0
750	0	2	7	16	9	16	20	4	0	0
700	0	4	8	16	9	16	20	5	0	0
650	0	6	8	16	10	16	20	6	0	0
600	0	9	8	16	10	16	19	7	0	0
550	1	9	9	16	10	16	19	7	0	0
500	2	10	9	16	10	16	18	9	0	0
450	3	11	9	10	11	16	18	7	0	0
400	4	11	9	16	11	16	17	8	0	0
350	5	11	10	16	11	16	17	8	0	0
300	6	12	10	16	11	16	16	8	0	0
250	7	12	10	16	11	16	16	9	0	0
200	7	12	10	16	11	16	16	9	0	0
150	7	12	10	15	11	15	15	9	0	0
100	7	12	10	15	11	15	15	*	0	.1
50	6	10	10	14	11	14	15	*	50	.4
S	5	8	10	13	11	13	15	*	70	1

*Fallout governs.
Tree blowdown type II forests.
Obstacles 2,100 meters.
Personnel 1,500 meters.

Table 3-9. Damage Circle Radii for 100 KT

Actual HOB (meters)	T	V	P	X	DP	DX	B	I	C	FAF
1,350	0	0	0	0	0	9	26	0	0	0
1,300	0	0	1	0	1	10	27	0	0	0
1,250	0	0	2	0	3	11	27	2	0	0
1,200	0	0	3	0	5	11	27	2	0	0
1,100	0	0	5	19	7	19	26	3	0	0
1,000	0	2	6	21	8	21	26	4	0	0
900	0	4	7	21	9	21	25	4	0	0
850	0	6	8	21	10	21	24	4	0	0
800	0	9	8	21	10	21	24	5	0	0
750	0	12	8	21	10	21	24	6	0	0
700	1	13	8	21	11	21	23	7	0	0
650	2	13	8	21	11	21	23	8	0	0
600	3	14	8	21	11	21	22	8	0	0
550	4	14	9	21	11	21	22	8	0	0
500	5	15	9	21	12	21	21	8	0	0
450	6	15	9	21	12	21	21	9	0	0
400	7	16	9	21	12	21	21	9	0	0
350	9	16	9	21	12	21	20	10	0	0
300	9	16	10	21	12	21	20	10	0	0
250	9	16	10	21	12	21	20	10	0	0
200	9	16	10	21	12	21	20	10	0	0
150	9	16	10	20	13	20	19	10	0	0
100	9	15	10	19	13	19	19	*	0	.2
50	8	13	10	18	13	18	19	*	60	.5
S	7	11	10	17	13	17	18	*	90	1

*Fallout governs.
Tree blowdown type II forests.
Obstacles 2,600 meters.
Personnel 2,000 meters.

Table 3-10. Damage Circle Radii for 200 KT

Actual HOB (meters)	T	V	P	X	DP	DX	B	I	C	FAF
1,700	0	0	0	0	0	0	33	0	0	0
1,600	0	0	2	0	2	9	33	0	0	0
1,400	0	0	6	24	6	24	33	0	0	0
1,300	0	1	8	28	8	28	33	2	0	0
1,200	0	4	9	28	9	28	32	3	0	0
1,100	0	7	9	28	9	28	31	4	0	0
1,000	1	13	10	28	10	28	31	5	0	0
900	2	16	10	28	11	28	30	5	0	0
850	3	17	10	28	11	28	29	5	0	0
800	4	18	10	28	12	28	29	7	0	0
750	4	18	10	28	12	28	29	7	0	0
700	5	19	10	28	12	28	28	8	0	0
650	6	19	10	28	13	28	27	8	0	0
600	7	20	10	28	13	28	27	9	0	0
550	9	20	10	28	13	28	27	9	0	0
500	10	21	10	28	13	28	26	10	0	0
450	11	21	10	28	13	28	26	10	0	0
400	12	21	10	28	13	28	26	10	0	0
300	12	21	11	28	14	28	25	*	0	.1
200	13	21	11	27	14	27	24	*	95	.4
100	12	19	11	25	14	25	24	*	85	.7
S	9	14	12	22	14	22	23	*	115	1

*Fallout governs.
Tree blowdown type II forests.
Obstacles 3,200 meters.
Personnel 2,400 meters.

Table 3-11. Damage Circle Radii for 500 KT

Actual HOB (meters)	T	V	P	X	DP	DX	B	I	C	FAF
2,200	0	0	2	0	2	0	46	0	0	0
2,100	0	0	5	0	5	4	46	0	0	0
2,000	0	0	7	0	7	7	46	0	0	0
1,900	0	0	9	35	9	35	46	0	0	0
1,800	0	0	10	40	10	40	45	0	0	0
1,700	0	4	11	41	11	41	44	0	0	0
1,600	0	7	12	41	12	41	43	0	0	0
1,500	0	10	13	41	13	41	42	0	0	0
1,400	0	15	14	41	14	41	41	2	0	0
1,300	1	22	14	41	14	41	41	3	0	0
1,200	3	24	14	41	14	41	40	4	0	0
1,100	5	26	14	41	14	41	39	6	0	0
1,000	7	27	14	41	14	41	38	7	0	0
900	9	28	14	41	14	41	37	8	0	0
800	11	29	13	41	13	41	37	9	0	0
750	12	29	13	41	13	41	36	10	0	0
700	14	30	13	41	13	41	36	10	0	0
650	16	30	13	41	15	41	35	10	0	0
600	17	31	13	41	15	41	35	11	0	0
550	17	31	13	41	15	41	35	11	0	0
500	18	31	13	41	15	41	34	11	0	0
400	18	31	14	40	16	40	34	*	0	.1
300	18	30	14	39	16	39	33	*	0	.3
200	18	29	15	37	16	37	33	*	115	.6
100	17	26	15	35	16	35	32	*	90	.7
S	14	21	16	32	16	32	32	*	155	1

*Fallout governs.
Tree blowdown type II forests.
Obstacles 4,800 meters.
Personnel 3,600 meters.

Table 3-12. Damage Circle Radii for 1 MT

Actual HOB (meters)	T	V	P	X	DP	DX	B	I	C	FAF
2,200	0	3	14	53	14	53	57	0	0	0
2,100	0	7	15	54	15	54	56	0	0	0
2,000	0	10	16	54	16	54	56	0	0	0
1,900	0	13	16	54	16	54	55	0	0	0
1,800	0	17	17	54	17	54	54	0	0	0
1,700	0	26	17	54	17	54	53	0	0	0
1,600	2	30	18	54	18	54	52	2	0	0
1,500	4	32	18	54	18	54	51	3	0	0
1,400	6	34	18	54	18	54	50	4	0	0
1,300	8	35	18	54	18	54	49	5	0	0
1,200	11	36	17	54	17	54	49	5	0	0
1,100	13	37	17	54	17	54	48	6	0	0
1,000	15	38	17	54	17	54	47	9	0	0
900	18	39	17	54	17	54	46	10	0	0
800	21	40	17	54	17	54	45	11	0	0
700	23	41	17	54	17	54	44	12	0	0
600	23	41	17	54	17	54	44	12	0	.1
500	24	41	17	53	17	53	43	*	0	.2
400	24	40	18	52	18	52	43	*	0	.3
300	24	40	18	50	18	50	42	*	0	.4
200	23	38	19	48	19	48	42	*	0	.6
100	22	33	20	46	20	46	41	*	130	.9
S	18	27	21	42	21	42	41	*	195	1

*Fallout governs.
Tree blowdown type II forests.
Obstacles 6,200 meters.
Personnel 4,600 meters.

Table 3-13. Damage Circle Radii for 2 MT

Actual HOB (meters)	T	V	P	X	DP	DX	B	I	C	FAF
2,200	0	28	22	72	22	72	67	0	0	0
2,100	1	38	22	72	22	72	66	0	0	0
2,000	3	40	22	72	22	72	65	0	0	0
1,900	5	43	23	72	23	72	64	0	0	0
1,800	8	44	23	72	23	72	64	0	0	0
1,700	10	45	22	72	22	72	63	2	0	0
1,600	12	47	22	72	22	72	62	3	0	0
1,500	14	48	22	72	22	72	61	4	0	0
1,400	17	49	22	72	22	72	60	5	0	0
1,300	19	50	22	72	22	72	59	6	0	0
1,200	22	51	21	72	21	72	59	9	0	0
1,100	25	52	21	72	21	72	58	9	0	0
1,000	28	53	21	72	21	72	57	10	0	0
900	30	54	21	71	21	71	56	11	0	0
800	31	54	21	71	21	71	56	12	0	0
700	31	54	21	70	21	70	55	*	0	.1
600	32	54	22	69	22	69	54	*	0	.2
500	32	53	22	68	22	68	53	*	0	.3
400	32	53	23	67	23	67	53	*	0	.4
300	31	51	24	65	24	65	52	*	0	.6
200	30	48	24	62	24	62	51	*	190	.7
100	28	42	25	59	25	59	51	*	140	.9
S	24	36	26	56	26	56	50	*	240	1

*Fallout governs.
Tree blowdown type II forests.
Obstacles 7,400 meters.
Personnel 5,200 meters.

Table 3-14. Damage Circle Radii for 5 MT

Actual HOB (meters)	T	V	P	X	DP	DX	B	I	C	FAF
2,500	10	63	31	104	31	104	87	0	0	0
2,400	12	64	31	104	31	104	86	0	0	0
2,300	15	66	30	104	30	104	85	0	0	0
2,200	17	67	30	104	30	104	84	0	0	0
2,100	19	68	30	104	30	104	83	0	0	0
2,000	22	70	30	104	30	104	82	0	0	0
1,900	24	71	30	104	30	104	82	0	0	0
1,800	27	72	29	104	29	104	81	3	0	0
1,700	29	73	29	104	29	104	80	4	0	0
1,600	32	74	29	104	29	104	80	5	0	0
1,500	36	75	29	104	29	104	79	6	0	0
1,400	40	76	28	104	28	104	78	6	0	0
1,300	42	77	29	104	29	104	78	9	0	0
1,200	44	78	29	103	29	103	77	11	0	0
1,100	45	78	29	102	29	103	77	12	0	0
1,000	45	79	29	103	29	102	76	13	0	0
900	46	78	29	101	29	101	75	*	0	.2
800	46	78	30	100	30	100	75	*	0	.3
700	46	77	30	99	30	99	74	*	0	.4
600	46	77	31	98	31	98	73	*	0	.4
500	46	76	32	96	32	96	73	*	0	.5
400	45	74	32	94	32	94	72	*	0	.6
300	44	71	33	91	33	91	72	*	0	.7
200	42	65	34	88	34	88	71	*	235	.8
100	39	59	35	85	35	85	71	*	100	.9
S	35	53	36	81	36	81	70	*	330	1

*Fallout governs.
Tree blowdown type II forests.
Obstacles 12,000 meters.
Personnel 8,000 meters.

APPENDIX A
REFERENCES

FM 6-40 Field Artillery Cannon Gunnery.
FM 101-31-1 Staff Officers Field Manual, Nuclear Weapons Employment.
FM 101-31-3 Staff Officers Field Manual, Nuclear Weapons Employment.
FM 105-5 Maneuver Control.

APPENDIX B
SAMPLE PROBLEM—STRIKE ASSESSMENT

B-1. General

This appendix illustrates the difference in strike assessments between a 1:50,000 and a 1:25,000 map.

B-2. Assessment Evaluation

a. Figure 2 shows the tactical deployment of company-size units of an Aggressor rifle regiment in a mobile defense. The scale of the sketch in figure 2 is 1:50,000.

b. The intended ground zero is illustrated for a relatively small-yield (7–12 KT) weapon which is to be employed against a rifle company occupying the second echelon of defense.

c. The procedures in chapter 2 will enable the umpires to determine whether the weapon is a dud, the location of the actual ground zero, and the actual height of burst.

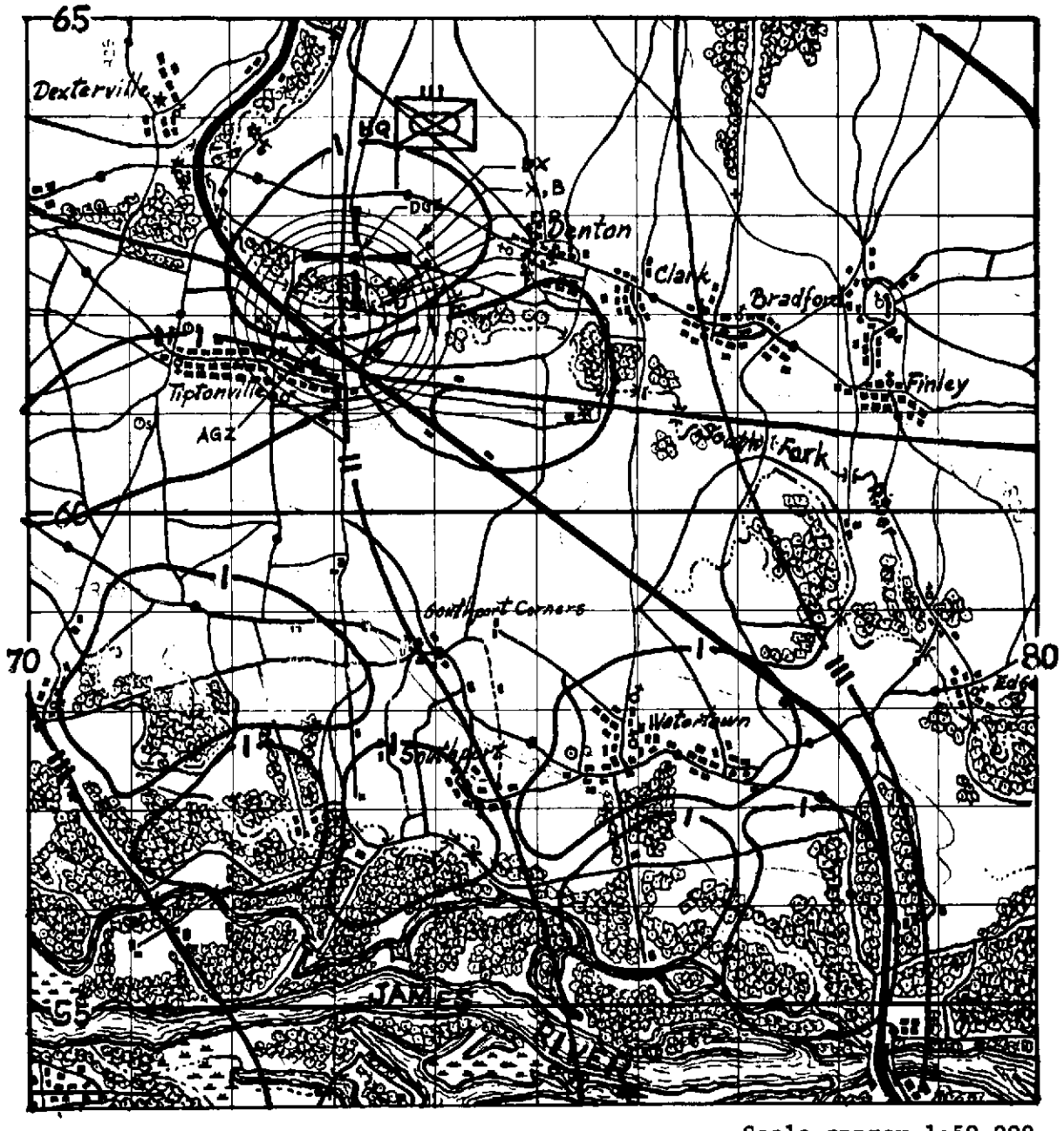
d. The damage radii are obtained from the appropriate table in chapter 3 and plotted on the map as shown in figure B–2. The following damage assessment is made from these data: About one-fourth of the protected personnel (P-circle) are immediate casualties, and a very few more will become casualties within 1 to 4 hours (DP-circle). Less than one-half of the exposed personnel (X-circle) are assessed as immediate casualties, with a maximum of 50 percent becoming casualties within 4 hours. About one-fourth of the exposed personnel and about one-tenth of the protected personnel in the adjacent companies are assessed as delayed casualties. No damage is assessed against tanks or wheeled vehicles. Buildings (B-circle) will be considered blown down to a distance equal to the radius of the X-circle.

e. Figure B–3 is an enlargement of the target area, showing platoon-size units for damage assessment.

f. When the damage radii are plotted around actual ground zero, a completely different evaluation may be made (fig. B–4). About one-half of the protected personnel of the two forward platoons are immediate casualties. This figure increases to about 70 percent for delayed casualties. About 90 percent of the exposed personnel of the forward platoons and one-half of the exposed personnel of the rear platoon are immediate casualties. These figures increase until about 95 percent of the exposed personnel of the entire company are casualties. None of the protected personnel of the adjacent companies are casualties and only about one-third of the exposed personnel of one platoon of one company (about one-tenth of the company) are casualties. Building destruction extends to the same distance. In this case, one tank can be assessed as destroyed.

Note. By the use of the larger scale map, training possibilities are enhanced by providing more realistic values from the casualty assessments. It can be seen from a comparative examination of figures B–2 and B–4 that enlargement of the target area facilitates the selection of ground zero and the subsequent assessment of damage to enemy troops.

Figure B-1. Aggressor rifle regiment in a mobile defense.



Scale approx 1:50,000

Figure B-2. Damage assessment for aggressor rifle regiment in a mobile defense.

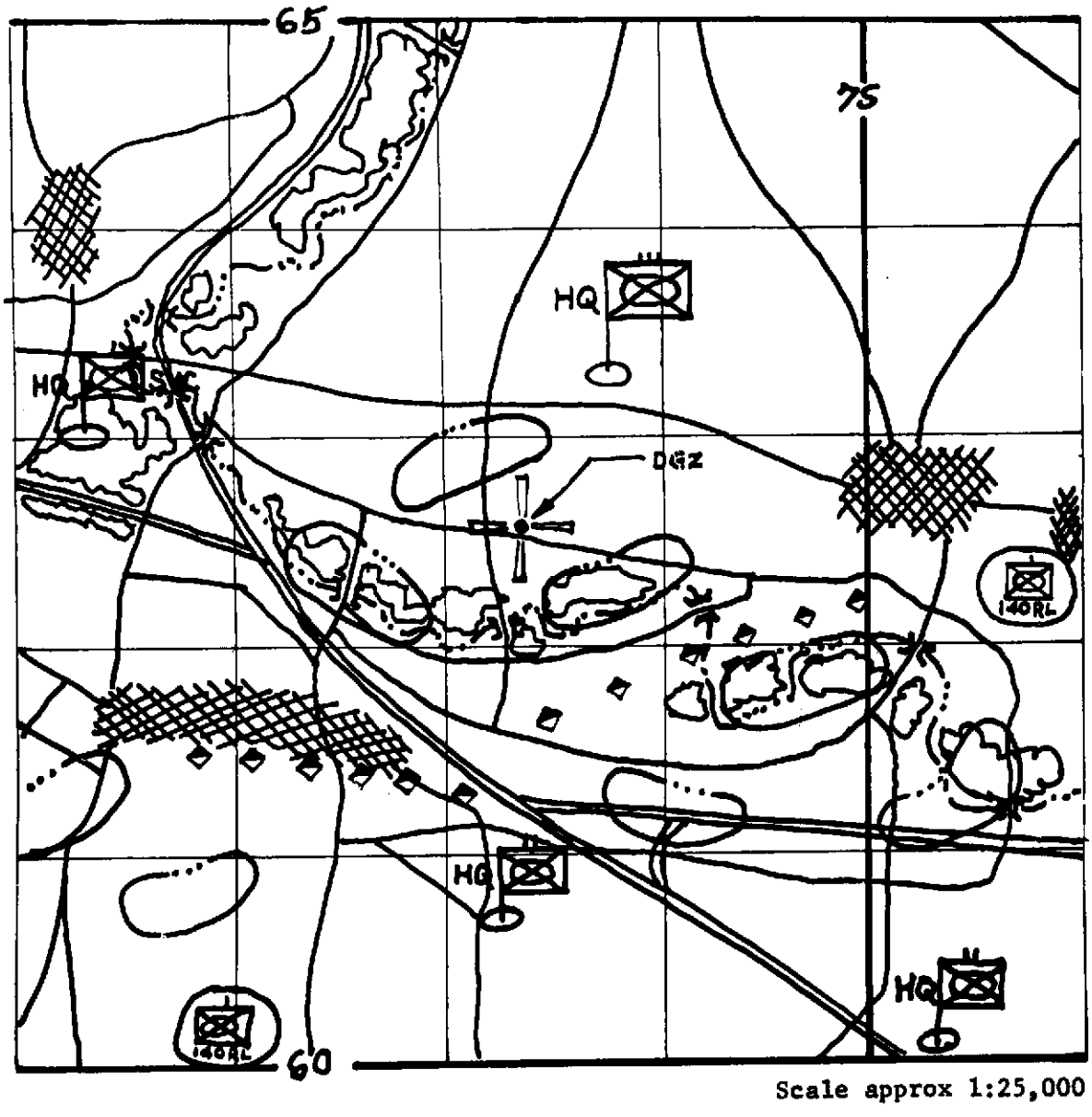


Figure B-3. Target elements displayed on a large scale grid sheet or map.

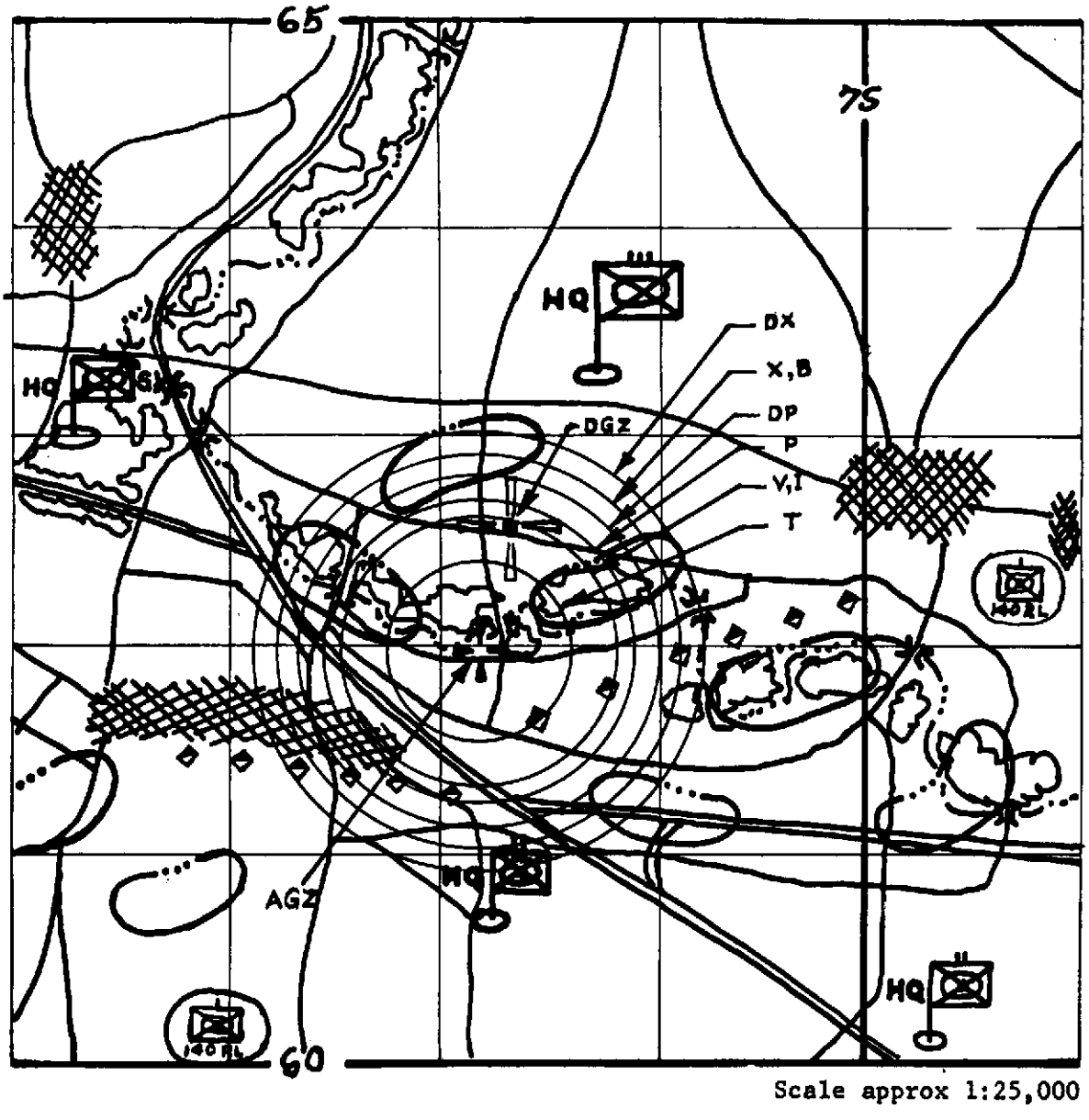


Figure B-4. Damage assessment for target elements displayed on a large scale grid sheet or map.

By Order of the Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
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NG: State AG (3).
USAR: None.
For explanation of abbreviations used, see AR 320-50.

☆ U.S. Government Printing Office: 1964—721783

APPENDIX C

NUCLEAR PLAY CALCULATOR AIDS

1. Horizontal dispersion templates (scales 1:50,000 and 1:25,000) for—
   a. Short, medium, and long range cannon
   b. Small and large free rocket
   c. Light, medium, and heavy guided missiles and air-delivered weapons
2. Damage circle template (scale 1:50,000)
3. Damage circle template (scale 1:25,000)

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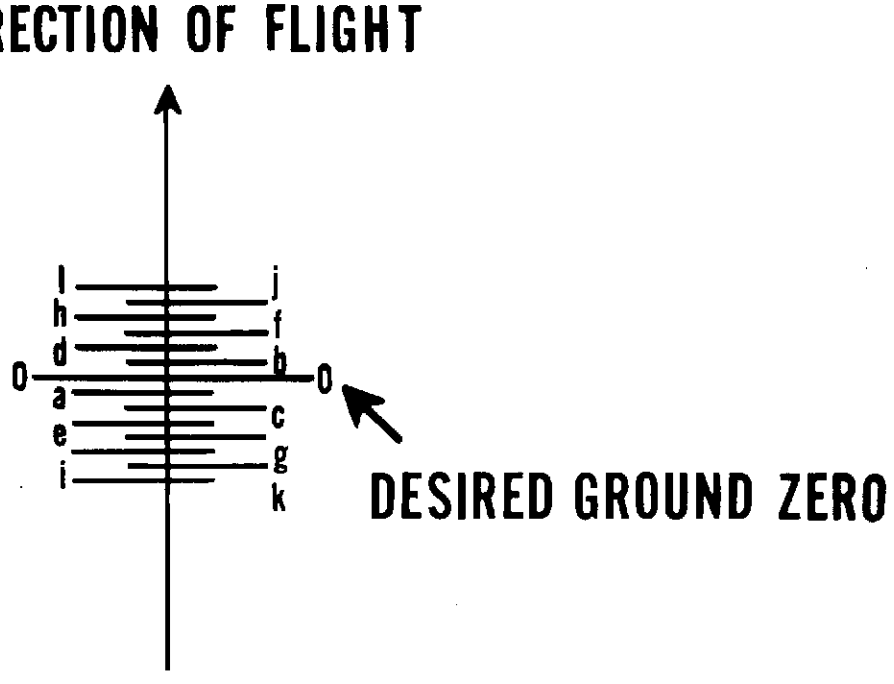
HORIZONTAL DISPERSION TEMPLATE

SHORT-RANGE CANNON
MEDIUM-RANGE CANNON
LONG-RANGE CANNON

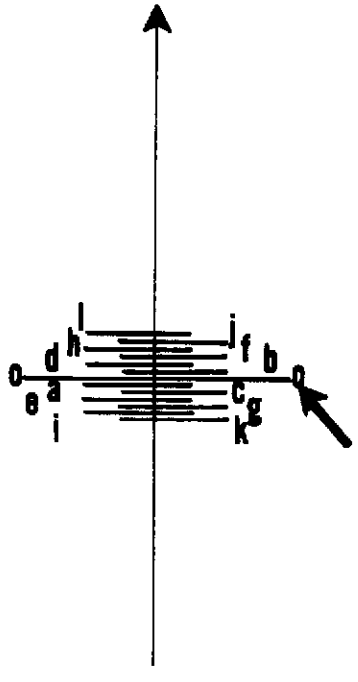


SCALE 1: 25,000

HORIZONTAL DISPERSION TEMPLATE

SHORT-RANGE CANNON
MEDIUM-RANGE CANNON
LONG-RANGE CANNON

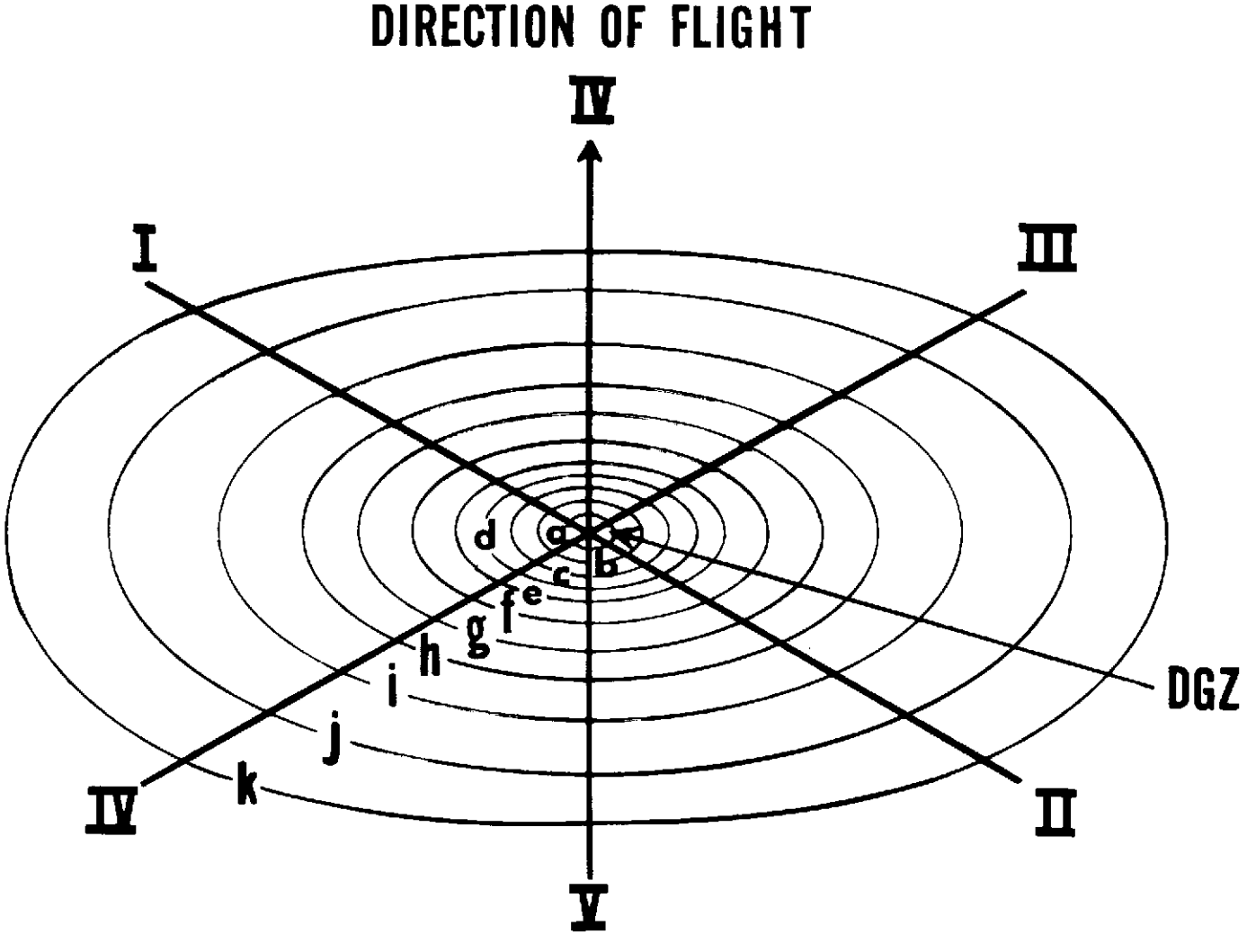
DIRECTION OF FLIGHT



SCALE 1 : 50,000

HORIZONTAL DISPERSION TEMPLATE

SMALL FREE ROCKETS
LARGE FREE ROCKETS

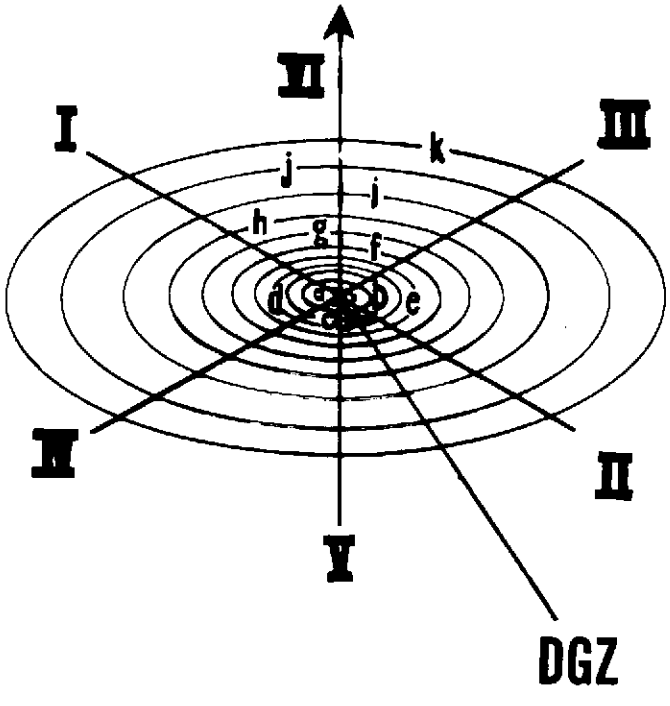


SCALE 1: 25,000

HORIZONTAL DISPERSION TEMPLATE

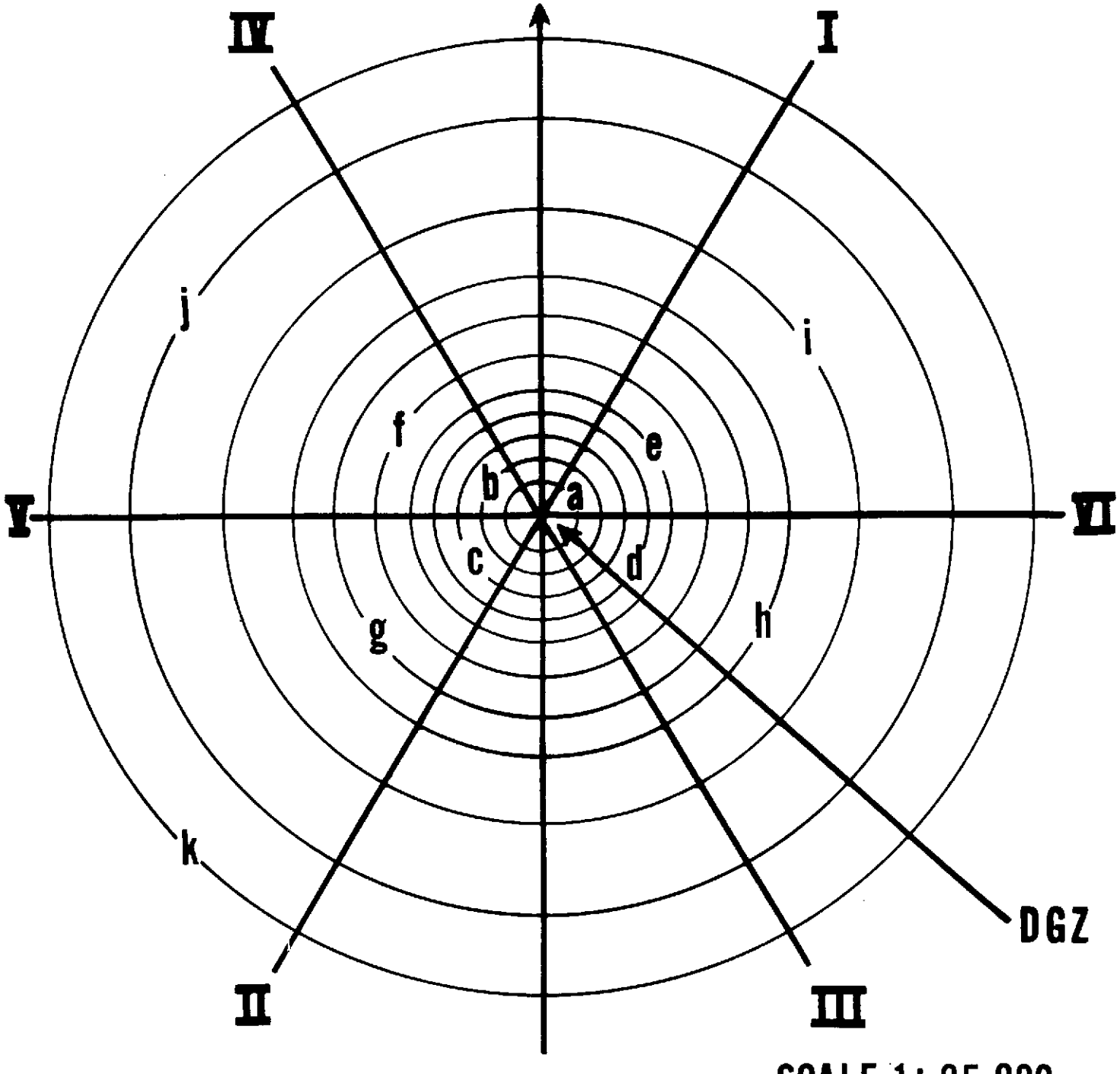
SMALL FREE ROCKET
LARGE FREE ROCKETS

DIRECTION OF FLIGHT



SCALE 1 : 50,000

HORIZONTAL DISPERSION TEMPLATE
LIGHT, MEDIUM, AND HEAVY GUIDED MISSILE
AIR FORCE DELIVERED WEAPONS

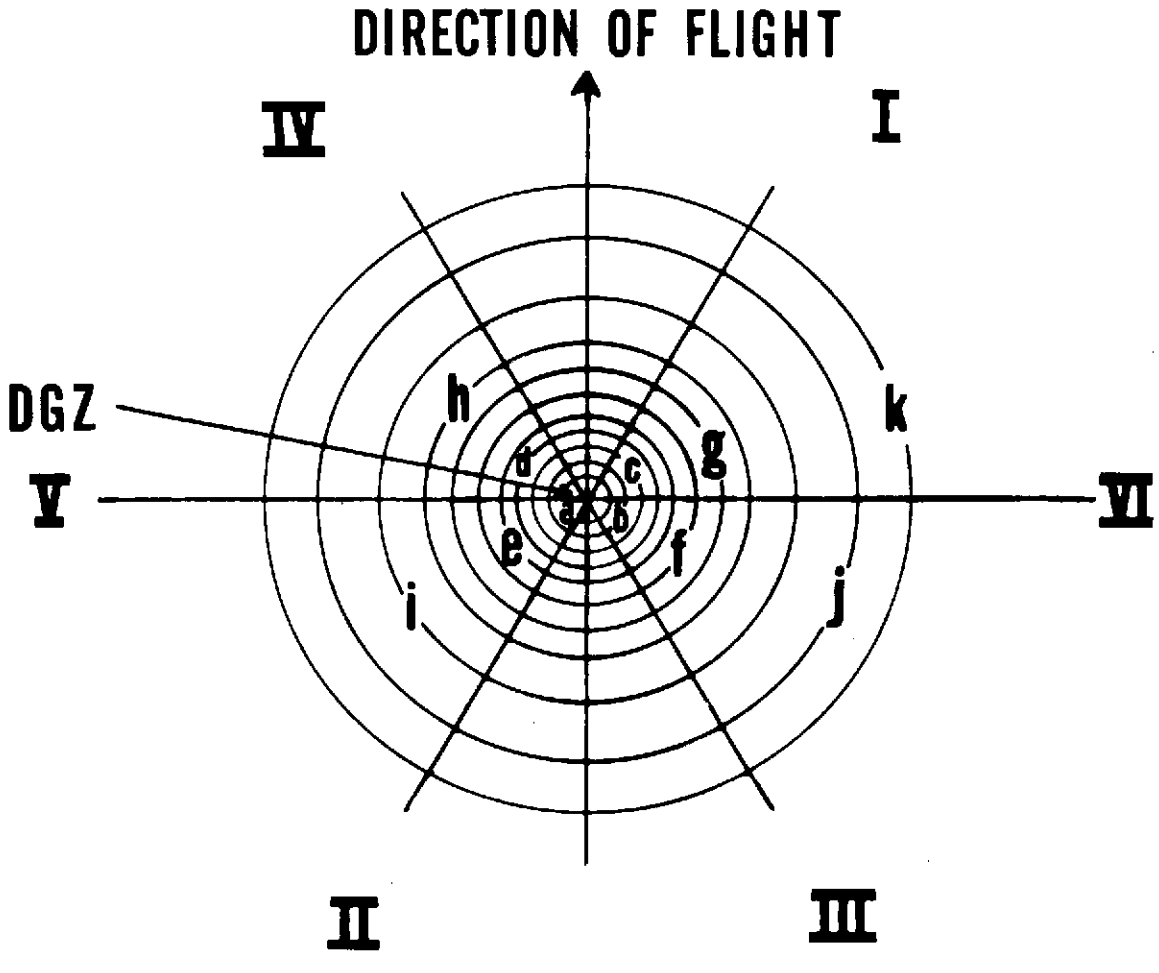


SCALE 1: 25,000

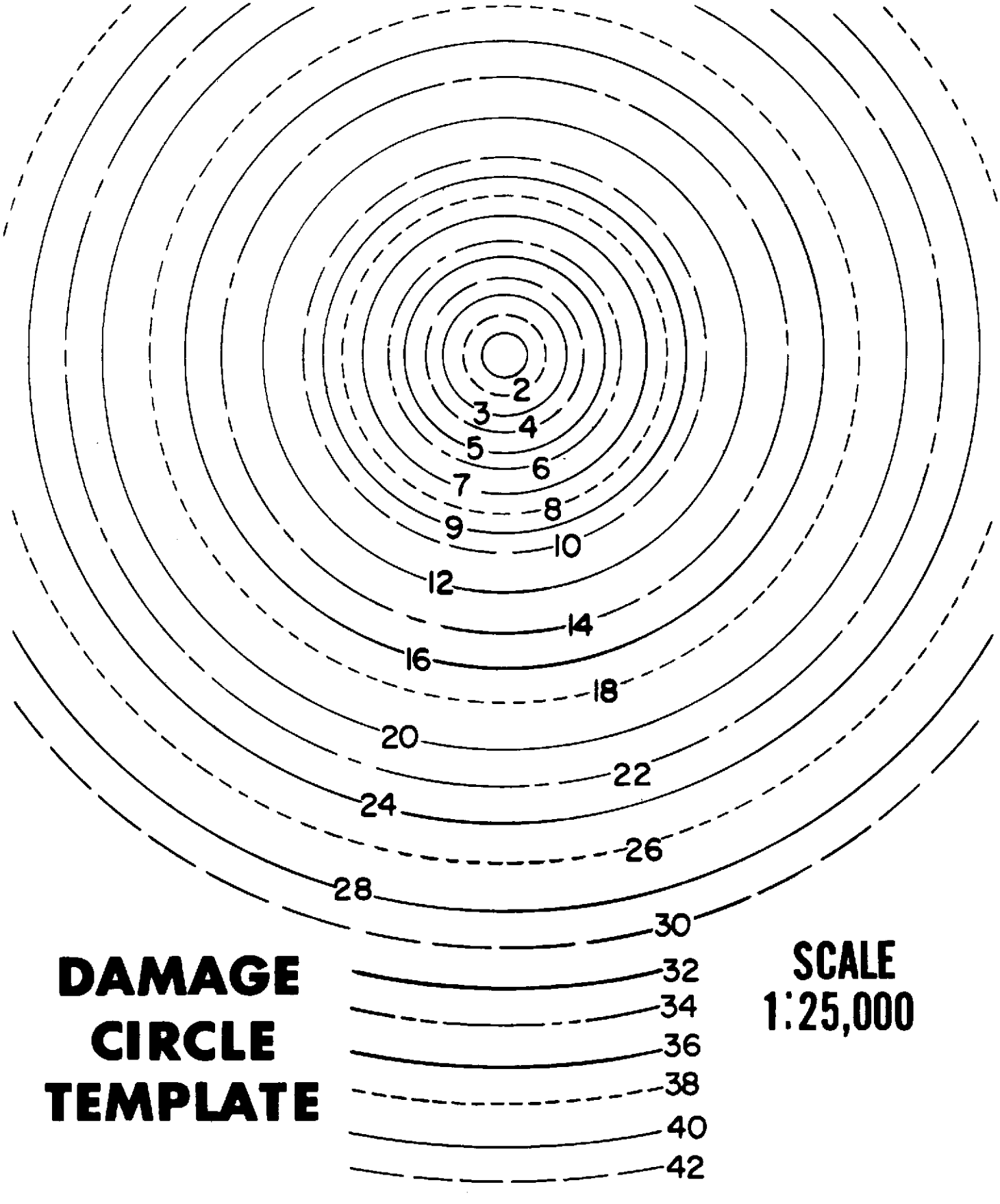
HORIZONTAL DISPERSION TEMPLATE

LIGHT, MEDIUM, AND HEAVY GUIDED MISSILES

AIR FORCE DELIVERED WEAPONS

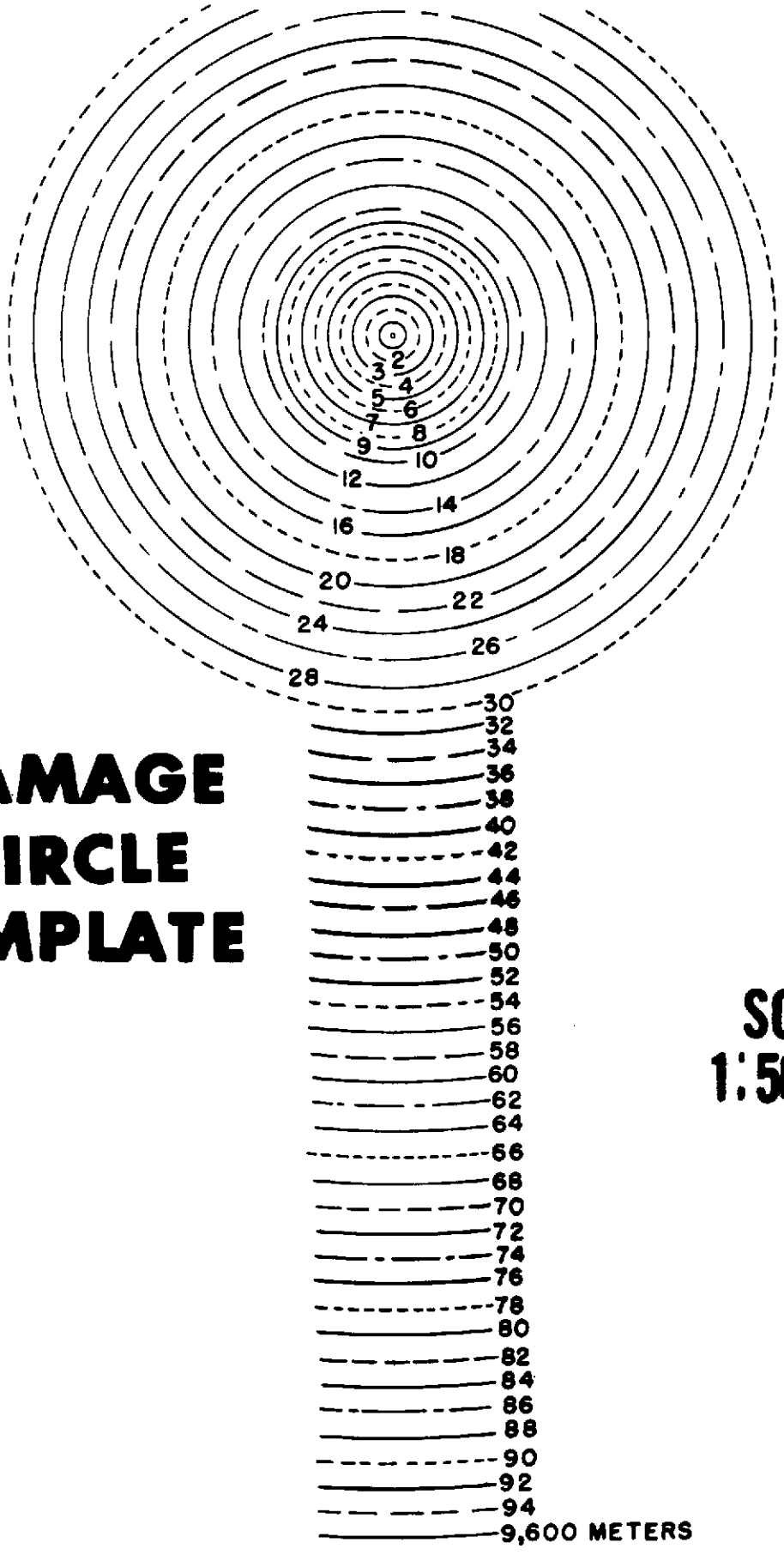


SCALE 1 : 50,000



DAMAGE CIRCLE TEMPLATE

SCALE
1:25,000



DAMAGE CIRCLE TEMPLATE

SCALE 1:50,000